



TENNESSEE DEPARTMENT OF

EDUCATION
FIRST TO THE TOP

Magic of Electrons (PLTW)

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Bethany King Wilkes, (615) 532-2844, Bethany.Wilkes@tn.gov
Course Code:	TBD
Prerequisite(s):	None
Credit:	N/A
Grade Level:	8
Graduation Requirement:	N/A
Coursework and Sequence:	This is the third course in the <i>Project Lead the Way (PLTW)</i> middle school sequence of coursework.
Necessary Equipment:	Visit www.pltw.org for more information.
Aligned Student Organization(s):	Technology Student Association (TSA): http://www.tntsa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	N/A
Available Student Industry Certifications:	N/A
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	001, 013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 101, 210, 211, 212, 213, 214, 230, 231, 232, 233, 400, 401, 402, 413, 414, 415, 416, 417, 418, 440, 470, 477
Required Teacher Certifications/Training:	<i>Project Lead the Way</i> training is required
Teacher Resources:	http://www.tn.gov/education/cte/doc/STEMResourceList.pdf

Course Description

This is a course in the series of *Project Lead the Way (PLTW)* curriculum. For more information, visit the PLTW website at <http://www.pltw.org/>.

Program of Study Application

These courses build knowledge and skills related to the following career clusters:

- 1) Architecture & Construction
- 2) Information Technology (IT)
- 3) Manufacturing
- 4) Science, Technology, Engineering & Mathematics (STEM)
- 5) Transportation, Distribution, & Logistics

Course Standards

The course standards outlined below are the copyrighted property of *Project Lead the Way*. Teachers must participate in *Project Lead the Way* training in order to be able to teach this course.

Lesson 6.1 What is Electricity? (16 days)

Understandings

- 1) Electron flow is created as electrons are transferred between atoms.
- 2) As engineers design electrical systems, they must understand a material's tendency toward being a conductor or insulator.
- 3) Current, voltage, and resistance are measurable quantities that are used to explain electron flow in an electrical system.
- 4) Magnets play an important role in creating electromotive force which is used to make and convert electricity.
- 5) Generators are used to convert mechanical energy into electrical energy, while motors convert electrical energy into mechanical energy.

Knowledge and Skills

It is expected that students will:

- Identify the roles of protons, neutrons, and electrons in an atom.
- Explain how charges interact to hold an atom together.
- Identify metals, metalloids, and non-metals on the periodic table.
- Explain the relationship between current, voltage, and resistance.
- Describe the properties of a magnet including polarity and defining characteristics.
- Explain the role of an electromagnet in the function of a DC motor and generator.
- Describe how electron transfer between atoms and the flow of electricity are related.
- Evaluate whether a material is a conductor, insulator, or semiconductor based upon its number of valence electrons and its position on the periodic table.
- Identify an element based on the atomic number given a periodic table.
- Identify metals, metalloids, and non-metals on the periodic table.
- Measure voltage and current using a multimeter.
- Demonstrate the characteristics and functions of an electromagnet.
- Identify the primary parts of a DC motor and demonstrate how it functions.
- Identify the primary parts of a generator and demonstrate how it functions.
- Compare and contrast the characteristics of a basic motor and generator.



Lesson 6.2 Electronics (17 days)

Understandings

- 1) An electrical circuit is a system made up of conductors and electrical components that form a complete path for electrical current.
- 2) Engineers use circuit diagrams to communicate components and functions of electrical circuits.
- 3) A variety of electronic components are incorporated into electrical circuits by engineers to achieve specific functions.
- 4) When building or diagnosing circuits, it is important to be able to measure voltage, current, and resistance.
- 5) Ohm's Law explains the mathematical relationship between voltage, current, and resistance.
- 6) The transistor is an important electronic device because it allows a small amount of current to control a larger amount of current.
- 7) Engineers, designers, and engineering technologists are needed in high demand for the development of future technology to meet societal needs and wants.

Knowledge and Skills

It is expected that students will:

- Identify the characteristics of series, parallel, and combination electrical circuits.
- Identify standardized schematic symbols using a chart.
- Distinguish between the functions and operations of fixed resistors, variable resistors, and photo resistors.
- Construct series, parallel, and combination electrical circuits.
- Sketch circuit diagrams using standardized schematic symbols.
- Construct and test physical electrical circuits based upon circuit diagrams.
- Integrate DC sources, lamps, switches, diodes, light emitting diodes, resistors, and capacitors into electrical circuits to achieve specific functions.
- Determine the value of a fixed resistor based upon the color codes on those resistors.
- Measure voltage, current, and resistance using a multimeter.
- Mathematically calculate voltage, current, and resistance using Ohm's law.
- Design a circuit that uses a transistor as a switch.

Lesson 6.3 Digital Electronics (12 days)

Understandings

- 1) The relationship between the binary number system, decimal number system, and ASCII characters make it possible for computers to communicate and process complex functions.
- 2) Computer processors are the key component of electronic devices and function based on logic.
- 3) Logic gates are depicted by their schematic symbol and truth table.
- 4) Digital wave forms that communicate binary digits are the means of communication within and among digital electronic devices.
- 5) Engineers decide upon inputs, outputs, and the logic necessary for an electronic device and communicate them using electronic circuit diagrams.
- 6) Engineers must decide on the necessary constraints and trade-offs in control systems.



Knowledge and Skills

It is expected that students will:

- Identify the relationship between the binary number system and the decimal number system.
- Describe the functions of NOT, AND, OR, NAND, NOR, and XOR gates.
- Convert binary numbers to Base-10.
- Convert ASCII characters to binary.
- Interpret logic scenarios to determine outputs based upon possible conditions within those scenarios.
- Create truth tables for logic scenarios and match those gates to truth tables.
- Create a digital wave form and graph it for a binary sequence.
- Communicate using electronic circuit diagrams.
- Use transistors as switches to create circuits that function as AND and OR gates.
- Determine the logic, sensors, gates, outputs, and other components needed to emulate existing electronic devices that utilize logic.
- Design, construct, and test device solutions for emulating common electronic devices that utilize logic.

